

In the Claims

The claims of the present application are as follows:

1. (currently amended) The combination of a chemical vapor deposition chamber and an apparatus for delivering a plurality of chemical vapor deposition fluids to said chamber, comprising:

said chemical vapor deposition chamber for processing a semiconductor substrate;

said apparatus for delivering said plurality of chemical vapor deposition fluids to said substrate, said apparatus attached to, and in fluid communication with, said chamber, and having a cavity comprising an inlet nozzle, a throat region and an exit nozzle,

said inlet nozzle having a first diameter adapted to receive a carrier fluid, and having a first pressure and a first temperature;

said throat region, having a first and second end, connected to said inlet nozzle at said first end, said throat region having a second diameter less than said first diameter and adapted to receive said carrier fluid from said inlet nozzle, said throat region having a second pressure lower than said first pressure and a second temperature, and having a first and a second aperture adjacent to said first and second ends for injecting, respectively, a first and a second chemical vapor deposition dopant into said throat region to allow for atomization of said first and second chemical vapor deposition dopants by said carrier fluid and mixing of said atomized first and second chemical vapor deposition dopants with said carrier fluid; and

said exit nozzle, connected to said throat region at said second end, having an exit pressure lower than said second pressure and a third temperature, said exit nozzle

having a third diameter greater than said second diameter to allow for a substantial decrease in pressure from said first pressure to said exit pressure, and configured to introduce said mixed atomized first and second chemical vapor deposition dopants and said carrier fluid in the chemical vapor deposition chamber.

2. (previously presented) The combination of claim 1 wherein said inlet nozzle having said first diameter is adapted to receive and funnel said carrier fluid to said throat region having said second diameter, said inlet nozzle narrowing at an angle in the range of forty to sixty degrees.
3. (previously presented) The combination of claim 1 wherein said throat region is configured to operate at a critical Mach number of 1.0.
4. (previously presented) The combination of claim 1 wherein said second pressure and said second temperature are selected to present a condition for atomization of said first and second chemical vapor deposition dopants.
5. (previously presented) The combination of claim 1 wherein said first and second chemical vapor deposition dopants comprise TEOS.
6. (Canceled.)

7. (previously presented) The combination of claim 1 wherein said throat region is configured to maintain said first pressure to be greater than said third pressure to enhance atomization of said first and second chemical vapor deposition dopants.
8. (previously presented) The combination of claim 1 wherein said throat region is adapted such that said second pressure is lower than said first pressure allowing for said first and second chemical vapor deposition dopants to be injected into said throat region.
9. (previously presented) The combination of claim 1 wherein said inlet nozzle is adapted to receive said carrier fluid at a constant flow rate ensuring said second pressure being maintained constant through said throat region.
10. (previously presented) The combination of claim 1 wherein said first and second chemical vapor deposition dopants are introduced simultaneously into said throat region without pre-mixing.
11. (Canceled.)
12. (previously presented) The combination of claim 1 wherein said exit nozzle expands to said third diameter from said throat region second diameter at an angle in the range of twenty to forty degrees.

13. (currently amended) The combination of a chemical vapor deposition chamber and an apparatus for delivering a plurality of chemical vapor deposition fluids to said chemical vapor deposition chamber, comprising:

said chemical vapor deposition chamber for processing a semiconductor substrate; and
said apparatus for delivering said plurality of chemical vapor deposition fluids to said substrate, said apparatus attached to, and in fluid communication with, said chamber, and having a cavity comprising an inlet nozzle, a throat region and an exit nozzle,

said inlet nozzle having a first diameter adapted to receive a carrier fluid, and having a first pressure and a first temperature, said carrier fluid comprising a process compatible gas selected from the group consisting of O₂, N₂, and He;

said throat region, having a first and second end, connected to said inlet nozzle at said first end, said throat region having a second diameter less than said first diameter, and adapted to receive said carrier fluid from said inlet nozzle, said throat region having a second pressure and a second temperature and having a first and a second aperture adjacent to said first and second ends for injecting, respectively, a first and a second chemical vapor deposition fluid into said throat region to allow for atomization of said first and second chemical vapor deposition fluid by said carrier fluid and mixing of said atomized first and second chemical vapor deposition fluid with said carrier fluid, said first and second chemical vapor deposition fluids comprise fluids selected from the group consisting of precursors and dopants; and,
said exit nozzle, connected to said throat region at said second end, having said second diameter, said exit nozzle configured to maintain said second pressure and said

second temperature, such that said exit nozzle is an extension of said throat region consisting of the same dimensions as said throat region, said exit region configured to introduce said atomized first and second chemical vapor deposition fluid and said carrier fluid in said chemical vapor deposition chamber.

14. (previously presented) The combination of claim 13 wherein said inlet nozzle having said first diameter is adapted to receive and funnel said carrier fluid to said throat region having said second diameter, said inlet nozzle narrowing at an angle in the range of forty to sixty degrees.

15. (previously presented) The combination of claim 13 wherein said throat region is configured to operate at a critical Mach number of 1.0.

16. (previously presented) The combination of claim 13 wherein said second pressure and said second temperature are selected to present a condition for atomization of said first and second chemical vapor deposition fluid.

17. (previously presented) The combination of claim 13 wherein said first and second chemical vapor deposition fluids comprise TEOS.

18. (Canceled.)

19. (previously presented) The combination of claim 13 wherein said throat region, having said second diameter, is adapted such that said second pressure is lower than said first pressure allowing for said first and second chemical vapor deposition fluid to be injected into said throat region.

20. (previously presented) The combination of claim 13 wherein said inlet nozzle is adapted to receive said carrier fluid at a constant flow rate ensuring said second pressure being maintained constant through said throat region.

21. (previously presented) The combination of claim 13 wherein said first and second chemical vapor deposition fluids are introduced simultaneously into said throat region without pre-mixing.

22.-25. (Canceled.)

26. (previously presented) The combination of claim 1 wherein said throat region further comprises a third aperture for injecting a third chemical vapor deposition dopant into said throat region to allow for atomization of said third chemical vapor deposition dopant by said carrier fluid, and allow for mixing of said atomized first, second and third chemical vapor deposition dopants with said carrier fluid.

27. (previously presented) The combination of claim 13 wherein said throat region further comprises a third aperture for injecting a third chemical vapor deposition fluid into

said throat region to allow for atomization of said third chemical vapor deposition fluid by said carrier fluid, and allow for mixing of said atomized first, second and third chemical vapor deposition fluids with said carrier fluid.

28. (currently amended) The combination of a chemical vapor deposition chamber and an apparatus for delivering a plurality of chemical vapor deposition fluids to said chamber, comprising:

said chemical vapor deposition chamber for processing a semiconductor substrate; and
said apparatus for delivering said plurality of chemical vapor deposition fluids to said substrate, said apparatus attached to, and in fluid communication with, said chamber, having a cavity comprising a cross-flow injector, said cross-flow injector comprising an inlet nozzle, a throat region and an exit nozzle;

said inlet nozzle having a first diameter adapted to receive a carrier fluid, and having a first pressure and a first temperature, said carrier fluid comprising a process compatible gas selected from the group consisting of O₂, N₂, and He;

said throat region, having a first and second end, connected to said inlet nozzle at said first end, said throat region having a second diameter less than said first diameter, and adapted to receive said carrier fluid from said inlet nozzle, said throat region having a second pressure and a second temperature and having a first and a second aperture adjacent to said first and second ends for injecting, respectively, a first and a second chemical vapor deposition dopants into said throat region to allow for atomization of said first and second chemical vapor deposition dopants by said

carrier fluid and mixing of said atomized first and second chemical vapor deposition dopants with said carrier fluid; and,

said exit nozzle, having an exit pressure, connected to said throat region at said second end for receiving said atomized first and second chemical vapor deposition dopants and said carrier fluid; and

wherein said chemical vapor deposition chamber is adapted to receive said mixture of atomized first and second chemical vapor deposition dopants with said carrier fluid from said exit nozzle of said cavity.

29. (previously presented) The combination of claim 28 wherein said exit nozzle has an exit pressure lower than said second pressure and a third temperature, said exit nozzle having a third diameter greater than said second diameter to allow for a substantial decrease in pressure from said first pressure to said exit pressure, and configured to introduce said atomized first and second chemical vapor deposition dopants and said carrier fluid in the chemical vapor deposition chamber.

30. (previously presented) The combination of claim 28 wherein said exit nozzle has said second pressure and said second temperature, such that said exit nozzle is an extension of said throat region consisting of the same dimensions as said throat region, said exit region being configured to introduce said atomized first and second chemical vapor deposition dopants and said carrier fluid in said chemical vapor deposition chamber.

31. (new) The combination of a chemical vapor deposition chamber and an apparatus for delivering a plurality of chemical vapor deposition fluids to said chamber, comprising:

said chemical vapor deposition chamber for processing semiconductor substrates;

said apparatus for introducing TEOS and other dopant fluids at a high pressure, while

not requiring the use of capillary tubes to create a pressure differential, said

apparatus attached to, and in fluid communication with, said chamber, and having a

cavity comprising an inlet nozzle, a throat region and an exit nozzle,

said inlet nozzle having a first diameter adapted to receive a carrier fluid, and having a

first pressure and a first temperature;

said throat region, having a first and second end, connected to said inlet nozzle at said

first end, said throat region having a second diameter less than said first diameter

and adapted to receive said carrier fluid from said inlet nozzle, said throat region

having a second pressure lower than said first pressure and a second temperature,

and having a first and a second aperture adjacent to said first and second ends for

injecting, respectively, a first and a second chemical vapor deposition dopant into

said throat region to allow for atomization of said first and second chemical vapor

deposition dopants by said carrier fluid and mixing of said atomized first and

second chemical vapor deposition dopants with said carrier fluid; and

said exit nozzle, connected to said throat region at said second end, having an exit

pressure lower than said second pressure and a third temperature, said exit nozzle

having a third diameter greater than said second diameter to allow for a substantial

decrease in pressure from said first pressure to said exit pressure, and configured to

introduce said mixed atomized first and second chemical vapor deposition dopants and said carrier fluid in the chemical vapor deposition chamber.